Cpt S 411

Assignment #: PA1

Participants:

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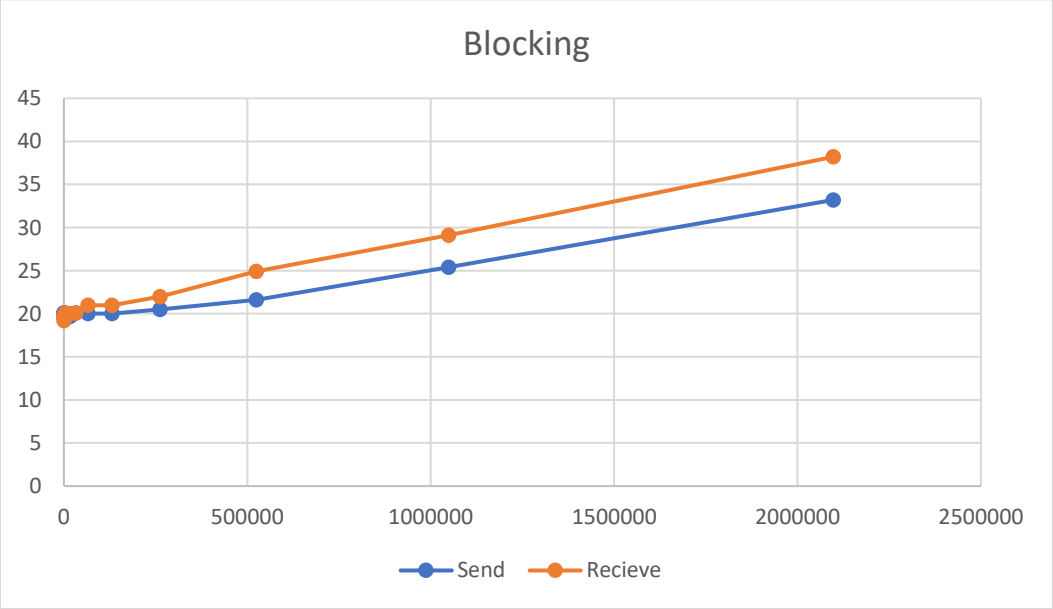
I certify that I have listed above all the sources that I consulted regarding this assignment, and that I have not received or given any assistance that is contrary to the letter or the spirit of the collaboration guidelines for this assignment. I also certify that I have not referred to online solutions that may be available on the web or sought the help of other students outside the class, in preparing my solution. I attest that the solution is my own and if evidence is found to the contrary, I understand that I will be subject to the academic dishonesty policy as outlined in the course syllabus.

Nate Jensvold

9/17/2020

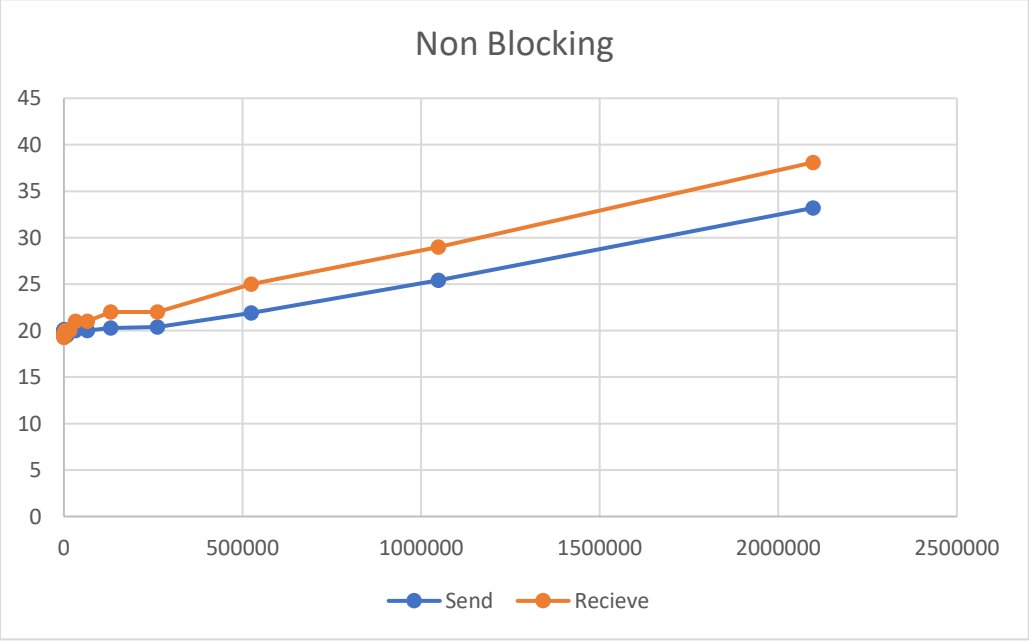
Blocking Data

Message Size(Bytes)	Send Avg	Recv Avg
1	20	19.4
2	20	19.4
4	20	19.2
8	20	19.8
16	20.1	19.6
32	20	19.8
64	20	19.5
128	20	19.6
256	20.1	19.6
512	20	19.2
1024	20	19.7
2048	20	19.6
4096	19.8	20.1
8192	19.6	20
16384	19.7	20
32768	20.1	20.1
65536	20	21
131072	20	21
262144	20.5	22
524288	21.6	24.9
1048576	25.4	29.1
2097152	33.2	38.2



Non Blocking Data

Message Size(Bytes)	Send Avg	Recv Avg
1	20	19.5
2	20	19.4
4	20	19.3
8	20	19.4
16	20.1	19.6
32	20	19.7
64	20	19.5
128	20	19.3
256	20	19.5
512	20	19.4
1024	20	19.8
2048	20.1	19.5
4096	19.6	20
8192	19.5	20
16384	20	20
32768	20	21
65536	20	21
131072	20.3	22
262144	20.4	22
524288	21.9	25
1048576	25.4	29
2097152	33.2	38.1



Derivation

To derive the latency, and bandwidth of a network the Hockney Model is used.

Hockney's Model

$$t(s) = l + s/b \qquad (1)$$

- *l*: latency of the network
- *b*: bandwidth of the network
- How can we determine the latency and the bandwidth?
  - Ping-pong benchmark:
    - process A sends a message to process B, process B sends message back
    - Advantage: does not require synchronized clocks between A and B
    - Disadvantage: assumes symmetric communication performance (costs (A->B) == costs (B->A)
- To determine latency: execute ping-pong benchmark for cnt=0

If we look at the data that we plotted above we know that all tests have a fixed cost of ~19ms when sending a message. If we take that fixed cost and plug it into the model as the latency, we will be able to use the formula to determine what the bandwidth of the network is for each message size.

Blocking Data

Message Size(Bytes)	Send Avg w/out latency(ms)	Recv Avg w/out latency(ms)	Send(byte/ms)	Receive (Byte/ms)
1	1	0.4	1	2.5
2	1	0.4	2	5
4	1	0.2	4	20
8	1	0.8	8	10
16	1.1	0.6	14.54545	26.66667
32	1	0.8	32	40
64	1	0.5	64	128
128	1	0.6	128	213.3333
256	1.1	0.6	232.7273	426.6667
512	1	0.2	512	2560
1024	1	0.7	1024	1462.857
2048	1	0.6	2048	3413.333
4096	0.8	1.1	5120	3723.636
8192	0.6	1	13653.33	8192
16384	0.7	1	23405.71	16384
32768	1.1	1.1	29789.09	29789.09
65536	1	2	65536	32768
131072	1	2	131072	65536

262144	1.5	3	174762.7	87381.33
524288	2.6	5.9	201649.2	88862.37
1048576	6.4	10.1	163840	103819.4
2097152	14.2	19.2	147686.8	109226.7

Looking at the table of calculations above the network bandwidth seemed to range from 1byte/ms - 201,649 bytes/s. However, if we drop all the data that had a send/recv time that is less than 1ms we get a much more focused range of 29789 bytes/ms – 201,649 bytes/ms. This data also leads to a conclusion that the network buffer size is somewhere between 32,768 Bytes – 65,536 Bytes because this is the first jump in time we get when we look at average send/receive time without latency included.

Latency: 19ms

Network Bandwidth: 29789 bytes/ms – 201,649 bytes/ms.

Network Buffer: 32,768 Bytes – 65,536 Bytes

Non-Blocking Data

Message Size(Bytes)	Send Avg w/out latency(ms)	Recv Avg w/out latency(ms)	Send(byte/ms)	Receive (Byte/ms)
1	1	0.5	1	2
2	1	0.4	2	5
4	1	0.3	4	13.33333
8	1	0.4	8	20
16	1.1	0.6	14.54545	26.66667
32	1	0.7	32	45.71429
64	1	0.5	64	128
128	1	0.3	128	426.6667
256	1	0.5	256	512
512	1	0.4	512	1280
1024	1	0.8	1024	1280
2048	1.1	0.5	1861.818	4096
4096	0.6	1	6826.667	4096
8192	0.5	1	16384	8192
16384	1	1	16384	16384
32768	1	2	32768	16384
65536	1	2	65536	32768
131072	1.3	3	100824.6	43690.67
262144	1.4	3	187245.7	87381.33
524288	2.9	6	180789	87381.33
1048576	6.4	10	163840	104857.6
2097152	14.2	19.1	147686.8	109798.5

Once again if we take out an average latency of 19ms we can get our real send/receive averages that each message size took. Using this “real” time I we are able to calculate an average Network Bandwidth of 1byte/ms-187,245bytes/ms. If we look at the data we can find a drop off in the “actual” send time of a message around a message size of 16,384-65,536 Bytes. This would suggest that somewhere in that

range of messages sizes we would find the network buffer size. If we only use the data from this point onward to calculate the bandwidth, we get a range of 16,384 bytes/ms - 187,245 bytes/ms.

Latency: 19ms

Network Bandwidth: 16,384 bytes/ms - 187,245 bytes/ms.

Network Buffer: 16,384 Bytes - 65,536 Bytes